SOIL CONSERVATION

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SOIL CONSERVATION

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SOIL CONSERVATION CAN HELP

BY JONATHAN FORMAN, B. A., M. D.[1]

AS THE WAR DRAGS OUT the treatment which we give our land gains in importance every day. When victory shall be ours, the fundamental problem will be the depletion of the soil. Upon the soil's productivity depends the success of our attempts to rebuild our own wealth and bring prosperity and peace to our land and health to our people. Upon the soil's productivity depends also our ability to help the peoples of other nations to develop their own securities.

Up until the beginning of the first World War, overgrazing was the greatest single factor in the distribution and deterioration of our grasslands. World War I lasted but a few months. In that short time, 10,000,000 acres of our topsoil were sent down the rivers of the Midwest. In the excitement of that war and in the hurry to grow grain for ourselves and our allies, we really began the mass destruction of our grasslands with mechanized equipment. Great batteries of tractors hauling gang plows tore up the sod 20 to 30 times as fast as it was turned over by the pioneer's horses. This was the day of the "factory" farm. In the heydays of war, farms made money but after the war came dust bowl and bankruptcy; combines fell apart in the fields; many were buried in the dust.

This war bids fair to last much longer. At least, we must avoid wishful thinking and for our own safety plan as though it will. This means a maximum load on American agriculture for years to come, while we fight the war and do our part in post-war international adjustments. This strain on our soil is a challenge to all of us who have any interest in conservation of natural resources.

The food-production program for ourselves and our Allies will lack foresight and come to meet disaster in the end unless it utilizes all that we know about soil management. For the winning of the war and the salvation of our people, our farms must no longer be operated as though they were mines; rather, they should be managed as the nicely balanced biological systems that they really are.

To win this war, and the peace, our people must be kept healthy. We cannot expect during these war days to attain optimum health, but we can keep ourselves reasonably free from disease and as physically fit as we possibly can on the food that we can grow. *It must not be forgotten in considering this problem that—as a country—we never have more than 60 percent enough food to set an adequate table.*

In the past, medical science has conferred upon those people who have availed themselves of the knowledge, the prevention of infections through vaccination and immunization, seemingly miraculous cures through new and powerful chemicals, and additional years, through the better feeding and care of babies. In the future, medical science promises to those individuals who will take advantage of the new knowledge of nutrition a greater stature, a better physique, increased resistance to infections, comparative freedom from the so-called degenerative diseases; the insertion of 10 additional years into the active mid-span of their lives; increased vigor and vitality at all age levels; the postponement of the usual signs of senility until the very end; more courage, better morale, a happier disposition, and a higher level of cultural attainment.

These will make almost a paradise of our peaceful days ahead. In the meantime, we must spend every effort to increase resistance against infectious diseases which always run wild in war time. Meningitis, tuberculosis, scarlet fever, measles, whooping cough, diphtheria and influenza threaten us. We must, therefore, pay much more attention to the matter of eating for health.

Because winning the war is so intimately bound up with the morale and political thinking of our people, we must do everything we can to ensure a

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good state of nutrition for all. When people are physically fit, they are alert; their judgment is sound. They are free from unnecessary fatigue and capable of doing a full day's work. They have endurance. They do not tire easily and, what is usually not emphasized, they do not worry. They meet problems of life with common sense. If we are going to have the capacity to do the tremendous amount of work that must be done by every man, woman, and child in this country, without shirking or rebelling, to the end that we shall make total war against our enemies—and if we are going to maintain the fortitude and courage that must be applied to the task of helping others to recovery—it is going to take the very best obtainable nutritional state in the bodies of every single one of us.

The quality of our nutrition depends upon the quality of our food. The quality of our food depends primarily upon the quality of the soil upon which it is grown. We must, therefore, see to it that our soil is made as fertile as possible—and everything done to keep it that way.

To do the work of the world we must have energy-producing foods. These are primarily the sugars, starches and fats. To produce growth and make repairs we must have proteins and minerals; in addition, we must have an adequate amount of those minerals and vitamins which are essential to life.

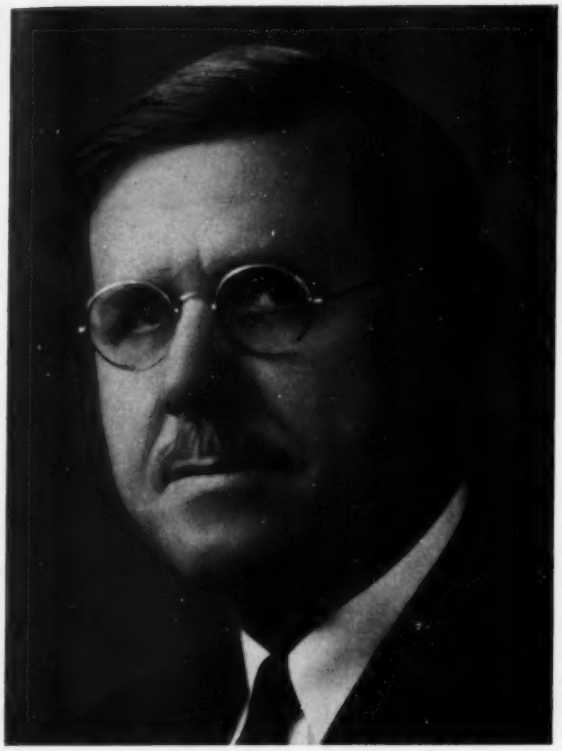
The severe "starvation dropsy" which has followed in the wake of every major war is brought about by a lack of protein in the blood serum of its victims. We shall hear much more about this desperate disease before the war is over as it breaks out among the people whom the Germans have enslaved. We need have little concern about it as a possibility for our own people. Nevertheless, we must make certain that every one of our citizens, in spite of whatever food restrictions may become necessary, shall have the amount of proteins necessary to the growth and repair of his body.

So *protein is our first concern among the vital foodstuffs*, both for ourselves and our domestic animals. Life cannot exist without proteins. They are essential constituents of every living cell. In addition, many of the enzymes and hormones necessary to the lives of ourselves and our domestic animals are protein in nature. This is also of great concern now that we know we must all build up our natural resistance to infectious diseases, or at least the capacity to develop such resistance against our age-old enemies of tuberculosis, smallpox, diphtheria, epidemic meningitis, scarlet fever, measles, and whooping cough. These diseases are gaining strength and virulence by passing through large numbers of under-nourished people. So when they reach us they are going to be that much more difficult to resist. If our people, then, are to outwit this threat of epidemics, not only must we and our children be immunized against small pox, diphtheria, lockjaw and whooping cough, but each must also have a smoothly operating mechanism to develop a high degree of resistance. All of these things, acquired immunity, natural resistance, ability to throw off infections once they gain an entrance, and the capacity to respond when physicians vaccinate, or give us immunizing injections, depend upon our having a complete reserve of amino acids.

Amino-acids are Nature's building stones out of which are constructed the various proteins. It was once thought that these amino-acids were of significance quantitatively only, but it is now known that certain amino-acids have qualitative significance and are essential for the formation of indispensable proteins in the animal organism. Of the 20 or more known amino-acids, some 10 are essential.

It must not be forgotten that the nutritive value of proteins varies greatly, depending upon the amino-acids that enter into their structure. In practical dietetics neither domestic animal nor man is ever restricted to a single protein as a source of necessary amino-acids. In general, however, we might suspect that proteins of animal origin would resemble more closely those of man and that, therefore, proteins in meat would have a higher nutritive value than those from any other source. Such is the case. As we would guess, milk and eggs contain all the amino-acids required by a growing animal. Most of us, however, get about 30 percent of our proteins from cereal. Here again, we get more protein if we use the whole grain of the cereal. The legumes, in general, contain rather high percentages of proteins. We may have to resort to them more and more as the war goes on. Cooking increases greatly their nutritive value. They, however, place a great drain upon the soil, and so more attention must be paid to maintaining the soil's fertility.

Protein depletion in our bodies may be the result of dietary deficiencies brought about by improper foods or possibly through the restriction of the diet because of certain diseases, the loss of serum proteins from the blood through the kidneys; or, it may result from the body's protein being burned to provide extra energy because the total intake of calories is too low. We, then, must add milk, eggs, meat, especially helpings from the internal organs, supplemented by whole-grain cereals, legumes, and potatoes if we are to get the necessary amino acids to build, repair, and protect our bodies. But the domestic animals that supply us with the milk, eggs, and meat can only get their proteins to pass on to



Dr. Jonathan Forman.

us from proteinaceous substances already fabricated by the plant. As Prof. W. A. Albrecht [1] points out, "They cannot use the simpler elements for making their proteins as in the case of the plants. . . . The feed quality of vegetation is largely a matter of whether it is mainly woodiness, or whether it is rich in minerals, protein, and all the accessories, both known and unknown, that the better forage feeds have."

As we call for forage rich in these nutrients, we are making greater and greater demands upon our soils. We must, therefore, be prepared to return the minerals which we borrow, and practice the wise use and conservation of all the vital elements, to the end that not only shall we have the health and strength to win this war, but shall come out of it with a soil with which we can begin again to recreate the wealth of the United States which we love and for which we have fought. This means we must not lose any of the important nutrients from the soil that ensure us a succulent proteinaceous forage.

The nutritional importance of the minerals becomes more clearly recognized, so that *it seems safe to hazard a guess that the great progress in nutrition in the immediate future will have to do with minerals.* The nutritional importance of calcium, phosphorus, magnesium, sodium, potassium, chlorine, iron, and iodine have long been recognized. Until recently, however, little importance has been attached to the presence in plant and animal tissues of copper, manganese, zinc, cobalt, nickel, bromine, silicon, strontium, vanadium, aluminum, fluorine or selenium. In fact, their presence was thought to be incidental. They were looked upon in animal tissues as accidental contaminants from the soil. Today, we are beginning to see that these so-called "trace elements" may have an important connection with the nutritional needs of the body tissues of both man and beast. *And so it is becoming doubly important in these days when the emphasis is on production not to forget quality.*

It is not necessary here to emphasize the great destruction the soils of the United States have undergone. We are merely concerned now with keeping what we have and restoring something of the virgin fertility if we can. In our virgin soils there were some score of minerals. It is becoming apparent that even those that are found in the minutest trace may play a vital part in the nutrition of plants, animals, and human beings. Of these many minerals none is more important than phosphorus. Many diseases of animals can be traced directly to the lack of phosphorus and its associated calcium in their foods, and these in turn, to deficiencies in soils that produced the foods.

We all know about the part that calcium (lime) plays in the growth of bones and teeth and how it maintains normal blood clotting, normal rhythm to the beat of the heart, normal excitability to the nerves and muscle, and regulates the permeability of the membranes, so that foodstuffs once in solution in the body, can flow into and nourish all of its cells. When calcium is deficient all of these important functions are affected unfavorably. The victims become irritable, nervous, and sometimes real problems in behavior.

It is possible to vary the calcium content of the salad leaf manyfold by varying the calcium content of the soil in which it is grown. *With improper farm practices, lime is the first element to be washed out of the soil.*

While supplemental feedings of these chemicals to our livestock and ourselves are much better than not getting them at all, supplemental chemicals are far from being as efficient as chemicals obtained from a healthy plant. The plant does something to this lime. Professor Albrecht notes that "using sheep demonstrated the fact that putting the lime on the soil makes

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lespedeza hay, for example, a much more efficient growth producer. Liming increased the yield of the hay by about 25 percent. Each pound of limed hay, however, was about 50 percent more efficient in terms of lamb growth resulting from consuming it. With the animals eating all the hay they could, those eating the hay given the proper soil treatment made 50 percent more gain. Because of the better crop yield, and the greater growth-producing efficiency of the hay, the limed acre was then about 75 percent more efficient in terms of increase in sheep weight." Professor Albrecht's studies show that unlimed hay was deficient in something which helped the animals (both sheep and rabbits) to build the calcium and phosphorus into their own bodies. They showed that the mere delivery of calcium into the digestive tract, and hence into the body of an animal, was apparently not enough. These essential minerals must enter into nutritional service for the plant first, if they are to be of the best service to the animal. The point of all this has been summarized by Professor Albrecht as follows: "As the soils become poorer for certain crops, and as substitutes are used, the substitute crops tend to become mere mineral haulers. Unfortunately, the minerals they deliver consist more of silica with no feed value, in place of calcium, phosphorus and all else of nutritive value that comes with them. An unbalanced plant diet offered by the soil cannot be offset by minerals added to the vegetative bulk used as feed, any more than wheat straw would be good feed when supplemented by saltpeter, limestone and bonemeal. Synthetic diets, at best, leave much to be desired." *The importance, therefore, of calcium and phosphorus to the welfare of ourselves and our children is becoming of increasing significance. We must learn to borrow these minerals and to return them again to the soil, if we are to survive.*

Those elements which are found in our tissues and in our foods in very minute traces are becoming appreciated. Almost everyone is familiar with the fact that in the Great Lakes Basin and in certain other areas of the world, iodine is missing from the soil. All are familiar, too, with the fact that the administration of a very small amount of this precious element to the masses of people directly through the use of iodized table salt, or indirectely through the use of iodized salt for the milch cows, prevents goitre and the development of those helpless idiots called cretins. Most of us, however, have not had the opportunity of seeing what iodine medication will do for children who are deficient but still getting a partial supply; how their little bodies develop, their brains sharpen, their nervousness and irritability disappear when they are given minute traces of iodine. More of us are familiar with iodine deficiency in swine which results in the birth of hairless pigs. We also know about iodine's effectiveness in increasing milk production. It has recently been shown that in many areas throughout the world soil is devoid of iron, and the children and livestock in such areas suffer from anemia. In some of these areas there is also lacking a trace of copper, so that it is sometimes necessary to add copper to iron to prevent or cure this anemia. In certain restricted areas there is a shortage of cobalt which must be corrected before the anemia is controlled. While it is agreed that copper must be available before iron can be used for making hemoglobin, we do not understand so well the function of cobalt. The fact remains that cobalt has to be added to the salt mixture in certain areas if anemias are to be prevented.

The great extent of boron deficiency on many Podzolic soils has been discovered in the past few years. Boron is known to be essential for plant life and one suspects that future investigations will show what it is good for in the human. Manganese is known to be essential for the hatching of eggs and to prevent sterility in rats. Its lack produces definite disease in sheep and cattle and chickens, zinc has been shown to be an essential element in the development of plants and its absence is known to cause serious disease among them. Physicians are awaiting anxiously results of investigations which suggest that zinc has a vital role in the production of one's own insulin, and so may be related to diabetes.

Although it has been generally accepted that soil that is rich in organic matter and the other nutrient elements will produce plants that are more nutritious for both animals and man, it is difficult to determine just what relationship each of the elements may have. The diverse nature of the reported experiments and field observations argues against anything but a general conclusion. The multiplicity of nutritive factors points strongly to the belief that a deficiency of any one of the several elements may lead to a state of poor nutrition. And in order to have a state of good nutrition for plants, animals and men, we must have a well balanced supply of all these elements in our soil. Certainly the available data do justify accepting a relationship between soil fertility, plant growth and its nutritive qualities, and animal growth, resistance to disease. and longevity.

The agricultural emergency is as much one of good nutrition as it is of acreage or total yield. Indeed, *we should think of the labor, fertilizer and seed factors in terms of nutritional results instead of*

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SHALL THEY LIVE
To Make the Crops and Feed the Troops?

By JOHN H. WETZEL

IF TOMORROW morning's newspapers were to carry the headline "No food available for the next 4½ days," we would be reading the most serious news since Pearl Harbor. The resulting confusion and hardships would seriously affect, if not completely undermine, our country's war program. It is hardly to be expected that this headline will ever appear, but the hypothetical loss of 4½ days' food supply for every person in the United States does have an appalling connotation. The time lost each year because of accidental injuries on the farms is equivalent to the labor required to produce this 4½ days' supply of food.

THE TIME LOST as a result of accidental deaths and injuries suffered by farm people in 1941 is equivalent to the labor required to produce 1,970,250,000 bushels of wheat or 1,313,500,000 bushels of corn, or 2,101,600,000 bushels of potatoes or 40,718,500,000 pounds of pork or 26,270,000,000 pounds of beef.

Made yet more graphic, this loss of time as a result of farm accidents translates itself into—

15 bushels of wheat for each person in the U. S.
or
10 bushels of corn for each person in the U. S.
or
16 bushels of potatoes per person in the U. S.
or
313 lbs. of pork for each person in the U. S.
or
202 lbs. of beef for each person in the U. S.

While the time lost as a result of farm accidents has always been important to the country's food production, it becomes infinitely more serious now that we are fighting for our very existence. The shortage of available farm labor is more acute today than ever before. Land armies are being formed. Men in the armed forces are being released to go back to the land. We are even bringing labor from across our borders to ease the situation. Still, the huge toll of active labor taken each year by farm accidents remains to sap the supply of available farm workers. The 18,500 farm people who are killed each year in accidents, and the almost 2,000,000 more who suffer injuries which require them to stop work—if kept well and functioning—certainly would furnish a welcome addition to the critical labor situation.

To the average urban citizen there is no occupation which seems more healthful, calm and serene than the outdoor life of the farmer. Plenty of fresh air. Lots of food fresh from the soil. No rush to make the morning bus or streetcar. Accident statistics, however, paint a different picture. The farmer is carrying on in one of the most hazardous of occupations. Out on the food production lines the yearly accidental death and injury toll far exceeds that of construction or manufacturing or transportation. The compensation insurance rate in one of our leading agricultural States is $4 for the farmer, 80 cents for the steel mill worker, and $1.50 for the cement plant employee. Even more alarming is the fact that the compensation rate for farm labor increased from $2.50 to $4 between 1930 and 1940. Ten years of climbing calamity—a decade of undercutting of the farm labor supply!

While the time lost as a result of agricultural accidents is vital to the crop production program, almost equally arresting is the effect which these accidents have on the Nation's pantry shelf—on every person who must eat if he would help win the war. In the scramble to make red and blue coupons come out even, farm accident prevention has indeed a vital place in everyone's daily life. A modern Utopia where no accidents occur may be beyond reach, but there is no gainsaying the benefits to be derived from even the smallest improvement in the record. A reduction of 50 percent in the number of farm accidents would help to clear up the present labor shortage and food crisis.

Wartime farming induces an increase in the number of accidents. Higher production means longer hours, greater weariness—eyes become less sharp by nightfall, hands and feet less sure. Early hours and late chores mean dim light in which to work, longer periods between meals. Raw workers, awkward movements, set the stage for mishaps. Young people, and old hands brought out of comparative retirement, find it easier for things to go wrong. Much of the hired help that is available is likely to be of

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War is enlisting the youngsters in many new and difficult farm jobs. Hazards increase.

a category not signifying A–1 physical condition. Unless stringent preventive measures are enforced, wartime labor supplies will not be all "net"—they will be tragically cut into by the accidents which, always far too numerous on farms, will become yet more commonplace.

No serious accident occurs except to an accompaniment of human suffering, and an accident on the farm creates much more distress than it would in town. There is no nearby hospital, and even in normal times the doctor may be 15 to 20 miles away. The present shortage of physicians, nurses, and hospitals in most rural areas is becoming acute and is certain to increase the distress caused by injuries. First aid training, which has recently become so much a part of the town dweller's daily life, and could go a long way towards relieving distress from injuries, is practically nonexistent on the farm. It is true that many first-aid classes have been held in rural communities as a part of the civilian defense training but the average farmer has not had the time, tires, or gasoline to enroll in one of these classes. Open wounds, unless accompanied by severe bleeding, often go untreated, and provide an ideal home for the deadly tetanus germs that are present in most barns and barnyards. The economic effect of farm accidents also must be considered, inasmuch as so often the gradual breakdown of many stable farm families and lands has had its origin in the disabling injury of the farmer or one of his family.

Just as farm accidents sap the strength of our country's agricultural manpower, so do farm fires sabotage our wartime food production. Any person who has seen the panic and helplessness that accompanies a farm fire, well realizes the effect a fire has on the farm family and the farm pocketbook. Each year more than $100,000,000 in farm property is destroyed by fires that might have been prevented. The damp hay in the barn, the overturned lantern and the lightning rod cable that is not grounded, all are saboteurs which must be guarded against day and night. That bright red glow in the evening sky does not always mean "just another barn" on fire—it may mean a lost life, and it is sure to signalize a financial catastrophe from which few farmers ever completely recover. As farm accidents are preventable, so are fires; rarely has a fire been caused by an "act of God" for which the stage has not been set by a careless act or a bit of thoughtlessness.

The minute the United States entered this war, the average farmer became more or less public property. It became his patriotic duty to stay on the job every possible hour to produce a maximum supply of food for his fellow men. His job will be more difficult and more hazardous this year than ever before. He can no longer obtain an adequate supply of repair parts for his machinery, he must work longer hours, and his hired help will be enlisted largely from the ranks of women, children, and retired farmers. All of these problems increase the possibility of accidents, both to the farmer and to his hired labor.

The problem of bringing about any material reduction in the number of farm accidents is so large that all possible support must be enlisted and advantageously employed. Industry has already shown the way by proving that accidents can be prevented,

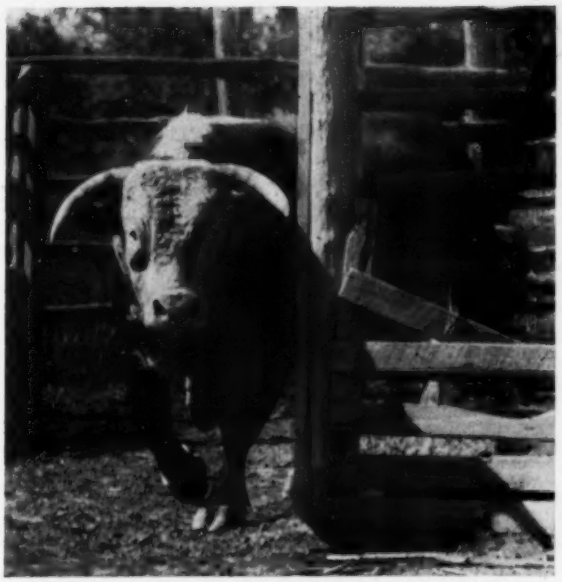
A broken ladder round; another casualty on the farm front.

and that it pays in actual dollars and cents to concentrate on a good safety program. This accident prevention and safety work in industry has become well established, and is operating according to definite safety codes and practices. It is now necessary to revise these codes so that their provisions will suitably apply to all agricultural endeavors.

Agricultural workers as a general rule are conscious of the fact that they are working in a field that is filled with hazards. Still, they are prone to take a chance either to save time, or because the proper equipment for the job is not available. To overcome this attitude, it is necessary to instill a "safety consciousness" in the minds of all workers, so that they are constantly mindful of their own safety and the safety of their fellow workers. In industry this consciousness has been successfully developed by means of safety meetings, safety training courses and the enforcement of specific safety codes. This plan is not practical for agriculture. After all, a farmer is his own boss, a fact which grants him the right to remove a machinery safety guard, or use a defective ladder to paint his barn if he so insists. There is no trained foreman at his elbow to point out the accident hazards, no safety director to fire him should he needlessly take chances and continually ignore the regulations that have been established for his protection.

Of the several ways available to carry the seriousness of the situation to the agricultural worker, undoubtedly actual personal contact with the farmer will produce the most satisfactory results. Constant repetition is the basis of all accident-prevention training, so the more times the farmer is cautioned to be careful the greater is the likelihood that any campaign will succeed. Group meetings of farmers, assembled for whatever purpose, offer an unusual opportunity to spend a few minutes on the subject of safety. Also, the many persons who daily contact the farmer might include a few words on accident prevention in their conversation. Rural newspapers, magazines, and the radio should not be overlooked as avenues of approach.

As with charity, safety begins at home. There is no better way of introducing the subject of accident prevention in the family circle than by having it carried home from school by the children. The farm youths of today are the agricultural workers of tomorrow. The spirit of safety planted in their open minds today surely will grow into a safety consciousness that will help to reduce the farm accident toll of tomorrow. What parent would not be impressed if his child cautioned him to be careful and not take a needless chance? In our effort to bring up children to be good citizens, we might well remember that to be a good citizen one must protect not only himself but others by being a safe worker.



Better to be safe than sorry; don't trust a bull, no matter how seemingly gentle.

Farm equipment and machinery manufacturers are doing their part. In the past few years more guards and safety appliances have appeared on farm machinery. Tags, decalcomanias, and bold-type printing in the instruction books caution the user to make certain that safety appliances are in place and in operating condition. Notwithstanding all these precautions, it is still difficult to pick up a rural newspaper and not read that an agricultural worker has been crippled or seriously injured while operating a piece of farm equipment. Regardless of how many safety devices are included on any machine, common sense and an intelligent regard for lurking danger is still the operator's best protection.

Realizing that definite action was needed to reduce the high farm accident rate, the Secretary of Agriculture on November 21, 1942, authorized the Soil Conservation Service, along with other Department agencies, to inaugurate a farm safety program. The objective was to enlist every agricultural worker in the United States in an immediate farm accident prevention campaign.

The interest shown by Soil Conservation Service employees in this new venture in accident prevention work was immediately apparent. They realized at once that *the conservation of soil and water fundamentally depends on the conservation of life and limb*. The intensive employee safety program and the vast number of direct daily farmer contacts placed

Soil Conservation Service employees in an opportune position to make a valuable contribution to a vital wartime need. For seven years accident prevention and safety have been an important phase of the Service employee-training program. The results are seen in an enviable safety record—a record which is steadily improving year by year. This in-Service training instilled a "safety consciousness" in the minds of employees which well prepared them to carry the safety message out to the farms themselves.

Early in the campaign it was realized that the safety doctrine requires considerable diplomacy in its advancement. No person likes to be told that his farm is an accident trap because of his own shortcomings. To avoid misunderstandings, a training course in farm accident hazards and their correction was inaugurated as a part of the regular employee safety program. This course prepares the employee to make sound, practical recommendations which will save life and limb as the farmer and his family go about their daily tasks—points out simple repairs in ladders and equipment, removal of obstacles, the right care and handling of equipment, the prevention of fires, and so on.

Soil conservation district supervisors are also giving valiant support to safety measures. These leading farmers in their own communities, knowing at first hand the alarming toll which accidents have taken among their neighbors, have shown real anxiety to organize and carry on an active farm safety program.

The problem is large enough to command the best efforts of all—city workers as well as those engaged in agriculture. The sabotage of the country's food production job is at stake. Farm accidents are hidden but immensely important factors in the much-discussed farm labor and national manpower situations.

The National Safety Council, which has carried an impressive responsibility in the marked reduction in industrial accidents, has now placed its experience, prestige and facilities behind the farm safety program. Other organizations are following suit. If the accident saboteur is to be suppressed, we must all strike hard and without delay.

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gross volume. In this paper so far I have been attempting to translate soil fertility into the needs of human nutrition. I have pointed out the growth materials of protein, and minerals, as well as the energy-producing materials of sugars, starches and carbohydrates; and I have noted that some of the elements found in the minutest traces in the soil have important functions in the regulatory mechanisms of the human body. *Good nutrition comes from good foods raised on good soil, but these foods must be properly digested and assimilated. In the process of assimilation vitamins stand out as of unusual importance.* Most vitamins are manufactured in plants for themselves, and are then eaten, absorbed and carried by the blood stream to the organs that need them. The animal organism does not have special storage facilities for vitamins. Without vitamins we cannot live. With a shortage of vitamins we only half live. This again places the emphasis upon the fact that we must use our land—invoking every conservation strategy—for the purpose of getting food rich in vitamins.

We must have a clear conception of what a vitamin is. A vitamin simply helps us to use our foods. Therefore, our vitamins should come in fruits, vegetables, milk, eggs, and meat, and not from the drug-store. Vitamins in pill and drop form are for the physician to give to sick people. Well persons should get their vitamins in each morsel of food they eat. Vitamins are not food. They do not furnish energy and are not utilized as building units for the structure of the body, but they are essential for the transformation of energy and for the regulation of the metabolism of the structural units. This is not the place to go into their nature except to point out that they are widely distributed throughout plant life and that animals are dependent upon plants for them with the exception of Vitamin D which can best be obtained from sunshine. The richer the soils, the better vitamin content have the plants grown thereon. Sometimes a mineral deficiency results in a partial deficiency of these essential substances. We know that small amounts of boron added to certain apple orchards will increase the Vitamin A content of the apples; that the use of very minute quantities of manganese may triple the Vitamin C content of tomatoes; and that liming may also increase vitamin content. The point of all this seems to be confirmation of the age-old axiom that *good soil produces good crops.*

We must be mindful of this in the present emer-

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DISTRICTS INVOKE DRAINAGE TO INCREASE CROP-GROWING AREA

By RAY W. CARPENTER

DRAINAGE is a "must" job in wartime food production in Maryland. The crops which Maryland farmers are being asked to produce in larger quantities are principally the clean-cultivated ones that encourage the spread of erosion if grown on rolling or hilly land. Inasmuch as most of the State's well-drained land suitable for crops is already used for that purpose, any attempt to increase plantings should be made on the more level lands. Here drainage work must be undertaken before peak production can be attained.

FORTUNATELY, a drainage program is already well under way in Maryland. The State is fortunate, too, in having on its statute books two laws which encourage drainage enterprises. The first of these is a soil conservation districts law which enables farmers to organize and direct local land use programs of permanent value. The second is the Drainage Law of 1941 which not only modernizes the old Maryland tax ditch law of 1844 but also complements the soil conservation districts act so effectively that there are now very few drainage problems in the State that will not yield to an economical solution through united group action. How these two laws work can best be told by outlining the development of Maryland's present drainage program during the past 7 years.

Wet land has always been a problem to Maryland farmers, particularly to those on the Eastern Shore, who sought to utilize land that seemed to possess all sorts of agricultural advantages except adequate drainage. Although the original Maryland "tax ditch" law was not enacted until 1844, tax ditches were organized by special acts of the legislature as early as 1826. In 1840 the legislature passed an act entitled "An Act for Clearing out of the Pocomoke River in Worcester County by Means of a Lottery." Under this law about $28,000 was spent to improve the drainage of the Pocomoke River by clearing fallen trees and logs from the channel. Most of the work was done by hand labor paid at the rate of 75 cents to a dollar per day.

When the "tax ditch" law was passed in 1844, farmers in other sections were able to organize local associations for the construction of community drainage systems of benefit to groups of individual landowners. Such tax ditch organizations possessed the power to levy assessments to compel each landowner to pay his fair share of the cost of the improvements; furthermore, they possessed certain rights of eminent domain, although the law was never fully interpreted in this respect.

Many drainage systems were constructed on the Eastern Shore following the passage of this law and a similar one in Delaware. These included feeder ditches serving individual farms, as well as main ditches. As long as cheap labor was plentiful the tax ditch organizations prospered but by the turn of the present century they had fallen on evil days. They were not large enough to enable the purchase of labor-saving equipment such as draglines. Some of the defects of the early drainage law became apparent, especially the absence of any effective provision for the collection of assessments for maintenance. Gradually, the tax ditch associations became inactive because they were not so designed as to keep abreast of changing developments. There was no room for a broad, vigorous program of land use.

The Pocomoke River is a good example of the decay of Eastern Shore drainage systems. Despite all the time and money lavished to keep it functioning effectively, it had deteriorated so badly by the early 1900's that much farmland which it was supposed to drain had reverted to woods and idle land. Formerly, this land was considered to be as productive as any on the lower Eastern Shore. Even today, much farmland still in cultivation in this area is subject to danger of partial or total loss of crops if heavy rains occur at any time during the growing season. The 200-day growing season is often shortened as much as 40 days because of inadequate drainage.

In 1935 came a CCC drainage program to Maryland and Delaware—the first active program to meet the situation. The work was under jurisdiction of the former Bureau of Agricultural Engineering of the United States Department of Agriculture and much of the direction of the projects was furnished by the agricultural engineering department of the

EDITOR'S NOTE.—Mr. Carpenter is head of the agricultural engineering department of the University of Maryland and from 1936 to 1939 served as district engineer for Maryland and Delaware in charge of CCC drainage projects conducted by the former Bureau of Agricultural Engineering, U. S. Department of Agriculture.

University of Maryland. Because regulations did not permit use of camp labor for drainage work on individual farms, all work was undertaken in cooperation with existing tax ditch associations and only main or outlet ditches were rejuvenated and rebuilt.

By July 1939 CCC enrollees from three drainage camps had cleared and constructed 250 miles of ditches, improving drainage conditions on nearly a quarter-million acres of land in Queen Annes, Caroline, Dorchester, and Somerset Counties. In Delaware, two camps located in Kent and Sussex Counties did a comparable job.

As benefits from the work became apparent, several of the counties concerned began appropriating county money for the purchase of dragline excavators. They also hired additional skilled operators. Public interest in Worcester and Wicomico Counties was spurred and soon local farm leaders were demanding a CCC camp to aid in improving the drainage conditions in the Pocomoke River watershed. After the State of Maryland had appropriated $30,000 and the two counties $10,000 apiece for the purchase of drainage equipment and supplies and for the hire of operators, a camp was established in 1939.

The second phase of the development of the present-day drainage program on the Eastern Shore began when jurisdiction of the CCC drainage camps was transferred to the Soil Conservation Service in 1939. Several new and fundamental contributions to the drainage program were made. First, the Service brought to the project techniques which simplified the maintenance problem. It also contributed research and demonstrations on how to develop grasses best suited to stabilize ditch banks. Finally, it made available additional engineering supervision and equipment.

Notwithstanding this added impetus, it became apparent early in 1941 that the drainage plans would have to be revised. The outlook was not bright for continuance of CCC help because of war and industrial conditions. If the camps were to be withdrawn, no agency would be left to direct and supervise the program. Nearly all of the equipment belonged to the CCC. Furthermore, CCC activities were limited to existing public or main outlet ditches, although there was strong need for assistance with the problems of drainage on individual farms.

Farmers, county commissioners, engineers, and others who looked into the matter agreed that the most logical solution would be the formation of soil conservation districts under the terms of the districts law passed by the State legislature in 1937. The soil conservation district type of organization was seen as offering numerous advantages, among them the following:

1. It offers a better chance for a permanent and flexible land use program.
2. It commands more attention of the agronomic, forestry, and wildlife aspects of drainage.
3. It makes available assistance on drainage problems of individual farms.
4. It provides an administrative set-up in a position to encourage a ditch maintenance program.
5. It assures an increase in local participation and responsibility in the district drainage program.
6. It is a means of getting Federal assistance in the form of technical help and equipment.

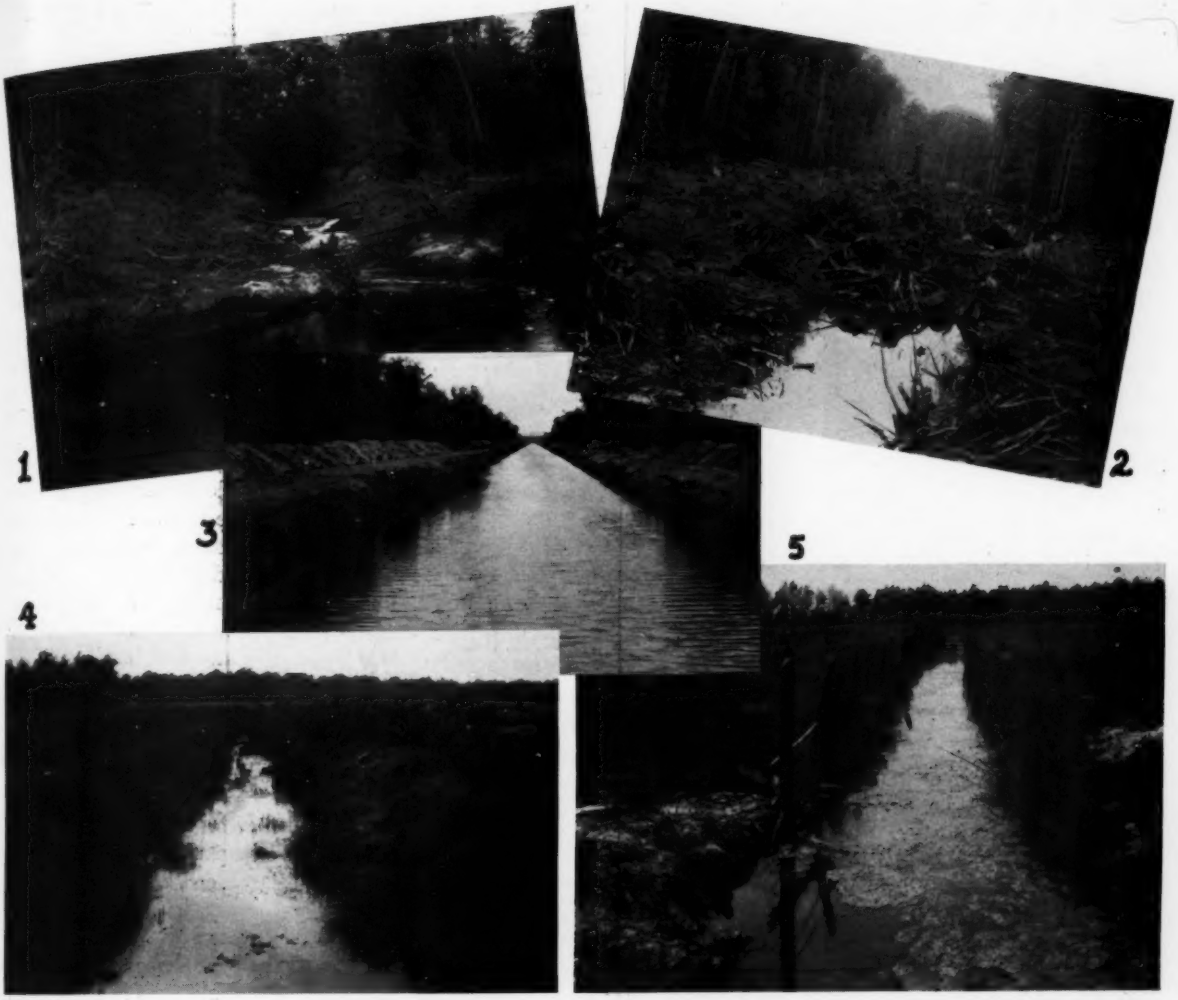
By 1940, public interest in drainage on the Eastern Shore became so great that the University of Maryland hired a full-time extension drainage engineer. He joined county agents and local farm people in recommending formation of districts to insure a continuing drainage program. They did not have to wait long for results. Soon farmers organized districts in Queen Annes, Caroline, Dorchester, Wicomico, and Worcester Counties. At the request of the district supervisors, Soil Conservation Service technicians and the Extension drainage engineer helped write plans and work out programs for drainage operations. After these operations got under way the Extension engineer spent much of his time in the districts in cooperation with district supervisors and Service personnel in putting the plans into action.

The third and present phase in the development of Maryland's drainage program finds these five districts actively engaged in drainage operations. Among other activities, five draglines are at work on public outlet ditches. Two of them are county-owned and one is State-owned. Four of the operators' salaries are paid by county appropriations.

In addition there are a number of tractor and blade outfits engaged in drainage operations on individual farms, with maintenance and operator costs paid by the districts. Several tractor outfits are at work leveling spoil banks. Here, too, costs are assumed by the districts.

This program has been stimulated by the new Maryland drainage law of 1941. A brief outline of this law's salient features might not be amiss. First, a local drainage association such as can be formed under the terms of the drainage law, can directly assess farmers for benefits received. A district cannot do this, but it is a very important prerequisite.

The drainage association can also levy taxes for ditch maintenance. Taxes for construction and maintenance are collected by the county treasurer the same way as other taxes. Many of the old tax



1. Drainage glimpse on property of John G. Rayne, Wicomico County (Pocomoke River), showing original channel at point where it enters new channel; distance water has to drop from old channel to new one can be noted. 2. Along the Black Dam Ditch, on properties of William Bunting and Willis Payne, Worcester County; original stream after clearing and blasting and just before excavation. 3. Section of new channel after excavation, property of Burbage heirs, Pocomoke River, Worcester County. 4. Love grass responded readily to seeding on the banks of Beetree Ditch where it flows through the properties of J. M. Marion and Clifton Walls in Caroline County. 5. A ditch where it flows through the Blackwater Game Refuge is edged by rush and sage marsh; the number of muskrats taken off the area served by this ditch rose from 30 to 137 after ditching.

ditches are being reorganized to avail themselves of this provision.

The drainage associations are specifically authorized to enter into agreements with county, State and Federal agencies in furtherance of their projects.

There are other advantages in the new drainage law but these seem to represent the main points of interest. Maryland farmers welcome the advantages offered by both the soil conservation districts and the "tax ditch" drainage associations. District supervisors work closely with tax ditch associations on finances, equipment and the hiring of labor, and in many instances have stimulated the organization of local drainage associations for specific drainage jobs.

With a set-up like this, it is natural that the district program in Maryland should be forging ahead in high gear. Maryland farmers have found a good way to increase their supply of crop-growing land, and they are making use of it.

BETTER MANAGEMENT BRINGS BACK THE RANGES

And Provides More Meat for Larders of United Nations

By E. A. JOHNSON

PROPER MANAGEMENT helps to keep good ranges good, and makes run-down ranges better. With armies marching on their stomachs, and beef a veritable munition of war, the good grasses of the rolling West yield vast dividends to intelligence and care. Stocking of ranges according to available forage increases the output of livestock on the range and adds to the meat supply for our armed forces, our allies, and civilian consumption. The resting of depleted ranges gives the grasses a chance to recover. The rotation of pastures, and the avoidance of too-early grazing, helps to fit the ranges for the fight they are being asked to wage.

I

One of the distinctive marks of an improving range is the dying of the poorer plants and their replacement by better ones. There is ample evidence in the general experience of successful ranching. A small part of the information available on this subject, recently submitted by region 6, indicates in a striking manner the improvement in vegetative cover that can be brought about in a few years by practicing good range conservation.

The semiarid climate prevailing in this region—New Mexico, Utah, Colorado, and Arizona—is comparatively unfavorable for luxuriant plant growth and rapid range recovery. Notwithstanding the limited and uncertain rainfall, and the further handicap of an overgrazed and eroded condition at the start, there are numerous examples of the crowding out of inferior forage plants by better ones—effective demonstrations of the restoration that can be accomplished if ranges are given full opportunity to recover under proper grazing use.

This is true not only in the Southwest but also in areas where climatic and physical land conditions are more favorable.

II

IMPROVED CONDITIONS ON ELENA GALLEGOS GRANT

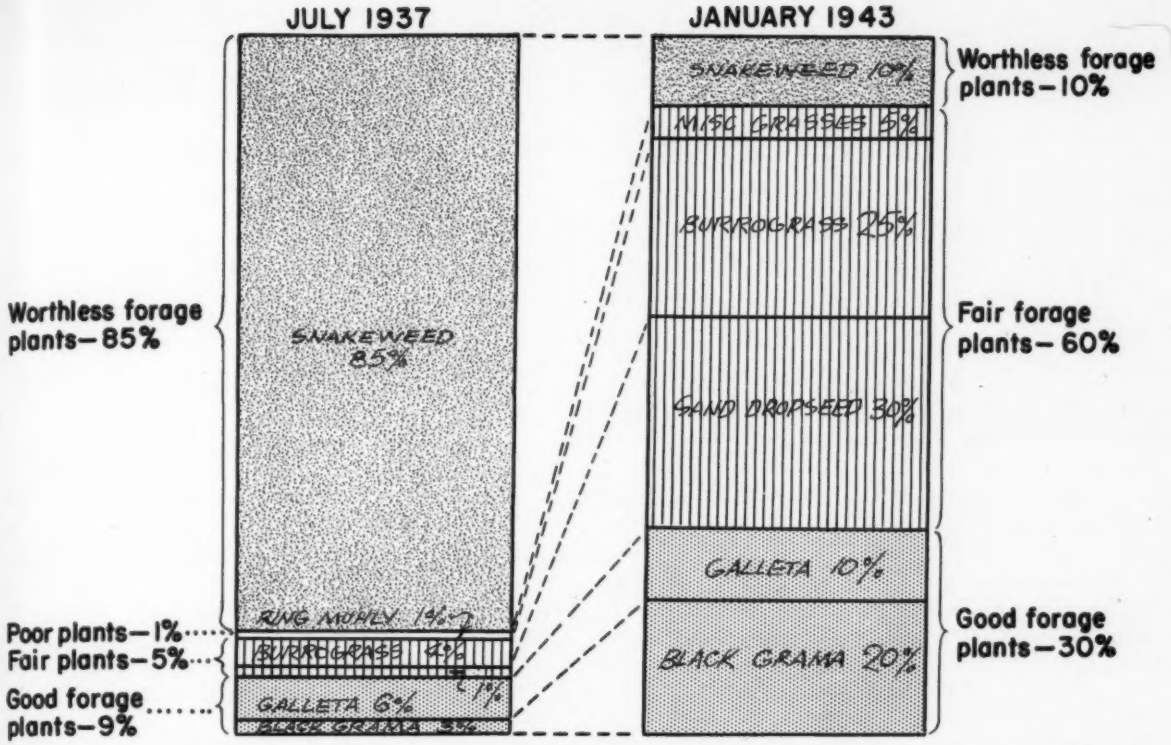
THE ELENA GALLEGOS GRANT, a range area of several thousand acres in New Mexico, was placed under cooperative agreement with the Soil Conservation Service in December 1937—long before the exigencies of war made peremptory a vast increase in the marketing of livestock. A range survey during the preceding summer revealed that the area had been heavily over-used by cattle and sheep for many years. As a result, the good forage plants originally on the range had been reduced in vigor and density. Many had died and had been replaced by undesirable or worthless plants, principally snakeweed. The range was producing only a fraction of its potential yield of forage and livestock products. Black grama, one of the better forage plants typical of this part of the country, made up less than 10 per cent of the total vegetative cover. Other plants such as sand dropseed and burrograss, normally abundant in this area, composed only 7 percent and 4 percent, respectively, of the plant composition. Only 5 percent of the ground surface was covered with vegetation. The transition wrought in a brief span of years is clearly indicated in the chart accompanying this article.

During 1937 and until the summer of 1938 the area was used to an unlimited degree by livestock from adjacent farms in the Rio Grande Valley. The grant was fenced in the summer of 1938. No grazing was allowed until the middle of October 1940, to give the more desirable types of vegetation an opportunity to regain vigor, to produce seed, and to build up a growing reserve. Thereafter the grazing was regulated in accordance with approved range-conservation principles, mainly proper stocking involving the use of specific numbers and kinds of animals.

During the fall and winter of 1940 only light grazing use amounting to 51 animal unit months was allowed. In 1941 this was increased to 161 animal unit months, and in 1942 to 479 animal unit months.

In addition to proper management, some water-spreading diversion and contour furrowing were

EDITOR'S NOTE.—The author is assistant chief, Range Division, Soil Conservation Service, Washington, D. C. Acknowledgment is extended to J. L. Lantow, A. R. Swanson, and Don Hubbell of region 6 who contributed data on which this article is based.



Portrayal of forage improvement through proper range management on a portion of the Elena Gallegos Grant, New Mexico, over 5½-year period.

done. Water-spreading undoubtedly aided in range recovery on the areas treated, but little if any improvement resulted from the contour furrowing. The recovery of the range as a whole may be ascribed mainly to improved management.

Marked improvement has occurred in the 5½ years from July 1937 to January 1943 in both the amount of vegetation on the ground and the kind and quality of plants making up the vegetative cover. On pasture No. 1, a tract of nearly 3,000 acres, the results achieved under the range conservation program may be summarized as follows:

1. An increase in the average density of vegetation from 5/100 to nearly 8/100, or a gain of 52 percent. Some areas show an increase of as much as 80 percent.

2. An average increase of 76 percent in the proportion of black grama in the composition, with some localities evidencing nearly 6 or 7 times as much of this valuable grass in the composition in 1943 as in 1937.

3. An average increase of 550 percent in the proportion of sand dropseed in the composition, with some localities showing as much as 30 times as much of this grass in the relative abundance of species as the range showed in 1937. Future years may show a slowing up in the rate of increase of this species as the more valuable species take their place in the vegetative picture.

4. Introduction of the valuable blue grama in some localities, and disappearance of poor species like three-awn, ring muhly, and fluffgrass in others, although in some instances these inferior species have come in as a natural, although temporary, component of the vegetation representative of the current stage in the process of plant succession.

5. An average decrease in the proportion of snakeweed in the total composition from 74 percent to 9 percent, amounting to almost complete disappearance in some areas.

6. An increase in the forage value of the pasture as a whole amounting to nearly 3½ times the forage value at the time the range conservation program was initiated. With steady improvement in soil and vegetative conditions under conservative stocking, the grazing capacity may be expected to increase still further until it reaches a maximum point which, in average years, will permit full use of the forage produced without impairing the value of the forage cover for soil protection, erosion control, and maintenance of soil fertility.

III

RANGE IMPROVEMENT ON THE ESPIRITU SANTO GRANT

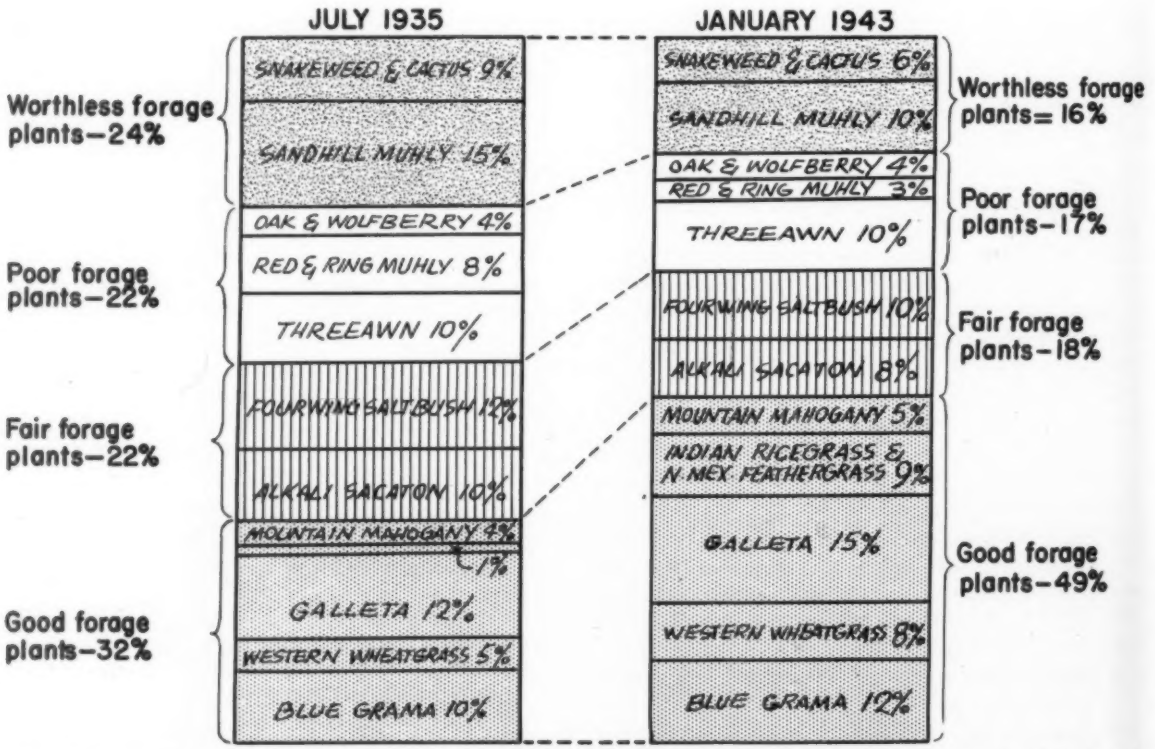
ON THE ESPIRITU SANTO GRANT, an area of about 120,000 acres in north central New Mexico administered by the Soil Conservation Service as a land utilization project, the valuable grasses similarly are reestablishing themselves. Although some mechanical treatment in the form of diversions, water-spreading, contour furrowing, and gully control had been applied, the rehabilitation has been due in large measure to good range management, particularly proper stocking.

Prior to purchase of the grant by the government in 1935, the range was grazed by large numbers of livestock. It is known that it was heavily stocked with cattle during the cattle boom of the eighties. During the period 1920 to 1937 the average use of the area was about 8,000 sheep throughout the year, which was almost double the estimated grazing capacity at the time the range conservation program was instituted. The heaviest use for which records are available occurred between the years 1929 to 1934 when 12,000 head of sheep were grazed throughout the year. In addition, several hundred head of horses and other livestock were known to have used the area.

The boundary fence was completed in 1936 and all unauthorized livestock were removed at that time. Since then the area has been stocked by both sheep and cattle as follows:

July 1, 1936, to June 30, 1940—805 animal units yearlong.
July 1, 1940, to June 30, 1941—870 animal units yearlong.
July 1, 1941, to June 30, 1942—1,010 animal units yearlong.
July 1, 1942, to June 30, 1943—878 animal units yearlong (authorized).

Improvement in vegetative conditions as determined by forage inventories made in July 1935 and again in January 1943 includes increase in the amount of ground surface covered by vegetation as well as changes in the kind and quality of plants making up the vegetative cover, as reflected in the second of the two charts accompanying this article. On the basis of studies made on representative portions of the range the density of ground cover on the area as a whole has increased about 15 percent in this



Portrayal of forage improvement through proper range management on a portion of the Espiritu Santo Grant, New Mexico, over 7½-year period.

7½-year period. The proportion of grasses, mostly valuable species, has increased in some places as much as 15 percent, and certain ones like western wheatgrass have tripled in abundance. Other desirable species showing increases are blue grama, galleta, and Indian ricegrass. On the other hand, such inferior plants as snakeweed, Russian thistle, cactus, tumblegrass, and other poor species showed a marked decrease in practically all areas and in some places has disappeared altogether.

Other substantial improvements have been made as well. Many of the formerly actively eroding gullies now have a vigorous growth of palatable grasses and are healing satisfactorily. There are numerous instances of a notable decrease in the amount of run-off water.

IV

WESTERN WHEATGRASS IN NEW MEXICO

AT THE NAVAJO EXPERIMENT STATION in northwestern New Mexico studies on the effect of various conservation practices on vegetation, soil, moisture supply, and their interrelationships have been in progress since 1935.

An outstanding instance of replacement of inferior plants by valuable forage plants is the remarkable recovery of western wheatgrass on a portion of the range included in this station. This grass, as the result of water-spreading, together with control of grazing, invaded many of the heavily silted areas. Originally making up only 1 percent of the total grass cover in 1935, western wheatgrass increased until in 1941 it made up 10 percent of the total.

Although the total amount of all vegetative cover on the ground decreased, due primarily to siltation, the total density of western wheatgrass increased about 4½ times, and in some localities nearly 60 times. In other places this valuable grass came in where there had been none before.

Dense stand of western wheatgrass growing in nearly 15 inches of sediment. It is now the dominant grass, having replaced red threeawn and other less desirable plants on areas where soil moisture conditions have been improved by water-spreading.

Here in these two pictures is an example of the effect of good range management on both forage and soil under the semiarid conditions prevailing in southwestern New Mexico. Above, 1938, is a depleted, heavily grazed stand of vegetation incapable of holding the soil. Below, 1940, the head erosion has been checked, the gully bottom is rapidly filling with vegetation, the plant cover on adjacent land has thickened considerably; the better forage plants have regained their vigor and the range as a whole is being restored to high productivity.

Some of the poorer species declined, especially annual forbs which generally decreased in abundance wherever the grasses markedly increased. Species replaced include such inferior plants as red three-awn, Russian thistle, and Watson's goosefoot.

It is significant that, notwithstanding the over-all reduction in total density of grasses, the total production of forage increased fourfold to tenfold due to increased height and volume growth.

V

NOT OVERNIGHT can the worn ranges of the Southwest provide a maximum meat output for the larders of the United Nations. They must be regrassed, and better grassed, and that takes more than a single season. But the war may be long, and post-

war needs will be great. Already fine progress has been made, is being made, and will continue to be made. The good grasses are coming back by sound management practices based on experience and research.

The farmer or rancher who desires to get the most out of his native range consistently, year after year, should observe carefully what is happening to the various kinds of plants, especially whether the better forage plants are increasing or decreasing in abundance and spread. A record of the better kinds of plants on a sample portion of the range will show how much the more valuable forage plants are increasing as the range improves. The amount of ground covered by all vegetation may also increase, especially if the range was badly run-down to start with. Such records show the progress of range improvement, and when combined with weather information and an analysis of how closely the better plants were utilized, furnish a basis for making the adjustments in grazing that are necessary for production of both forage and livestock on a high level.

CONSERVATION COMES TO THE SHARP SLOPES OF PUERTO RICO

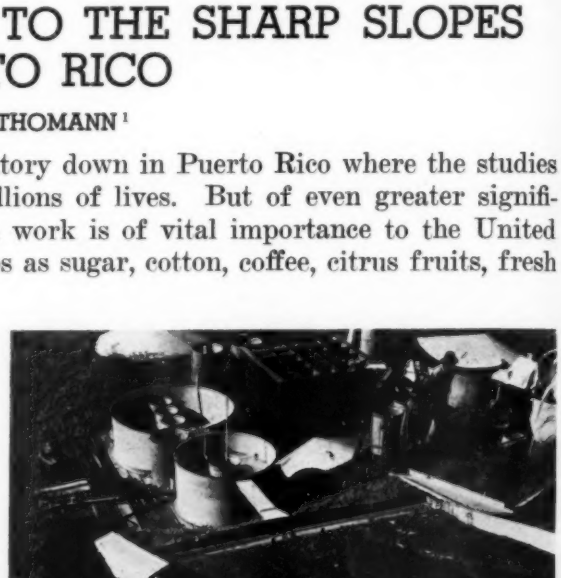
BY LOUIS F. THOMANN[1]

THERE'S A TROPICAL outdoor laboratory down in Puerto Rico where the studies under way on conservation farming affect millions of lives. But of even greater significance than the domestic benefits, this research work is of vital importance to the United Nations as it bears on production of such crops as sugar, cotton, coffee, citrus fruits, fresh vegetables, and pasture grasses.

OBSERVATIONS made by the Soil Conservation Service at the Mayaguez Experiment Station since 1937 are more than mere recordings of the effects of torrential rains beating upon the steep slopes of lateritic soil. Designed to ascertain the causes and effects of run-off and soil erosion, and to develop measures of control, the project also has delved into cultural methods and terrain reformation. Through these studies, the farmers of the island are learning to save soil, make the best use of intense rainstorms, and provide a better standard of living for their families.

Conditions of soil and climate at the experiment station are common to all of the tropics, and especially the Antilles. Slopes of the Cialitos, Catalina, and Mucara soil types vary from 10 to 60 percent. Annual rainfall averages 82 inches with monthly variations from 2 to 11 inches. There is run-off of water from about 90 percent of the rainfall with a wide difference between seasons. Run-off occurs on a total of less than 10 days during the dry winter months of December, January, and February; however, there is run-off on about one out of every three days in the wet months of May through September.

Although variability in rain intensity was found an important factor in causing variations in rates of run-off and erosion, vegetative and soil conditions tended to counteract and minimize the effects of increased intensity. Evidence from 374 farms showed that grass-covered plots lost much less soil than bare plots. There was an average annual soil loss of 2,321 pounds per acre in Guinea grass, as compared with a loss of 382,151 pounds of soil from a desurfaced acre.



Tank crew weighing run-off after a 3.30-inch rain at the Mayaguez research station.

Difference between the run-offs from two methods of planting sugarcane was slight, but the rates of erosion on plots planted in holes was significantly greater than the erosion on plots planted on the sides of contour furrows. The furrows acted as settling basins and, too, there was a more even distribution of stalks across the contoured rows to check soil loss further.

[1] Current Information Section, Soil Conservation Service, Washington, D. C.

Two cultural methods of growing coffee shaded by bananas were compared for relative amounts of run-off and erosion. An older method, a "ground skinning" or "pica tierra" process, consisted of cutting all grass and weeds closer than 2 inches to the surface of the ground prior to coffee harvesting and at two other times during the year. By the newer method, the grass was permitted to grow uncut except for a bare ring 1 foot in radius about the coffee plant. Each plot was one-fiftieth of an acre in size, each had a similar density of overhead canopy formed by banana and other trees, and each had an average slope of 61 percent.

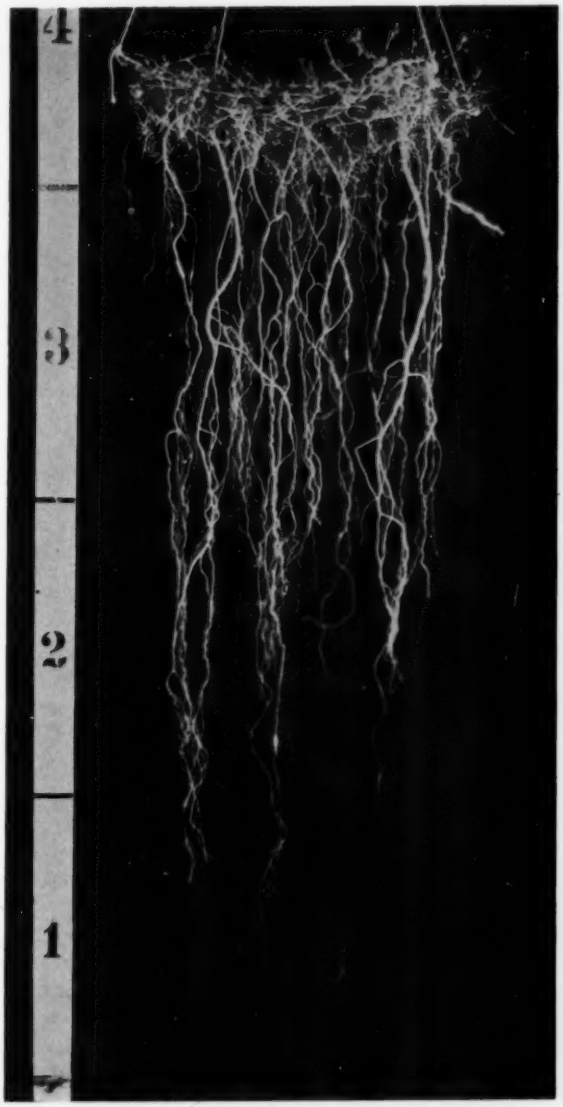
Results indicated that increases in rainfall intensities were, as usual, associated with increases in rates of erosion and proportion of rain which ran off from both plots. Studies of 115 rains definitely showed that the method of "ground skinning" the soil surface of grass and weeds 3 times a year was from 2 to 10 times as wasteful of soil and water as the method wherein the grass was cut only within a foot of the coffee plants.

These experiments with sugarcane and coffee plants are of extreme importance to the agricultural economy of the tropics and of special significance to millions of ration-minded Americans in the United States.

A study was made of 155 rains upon four nonvegetated plots, two of Catalina subsoil and two of Catalina topsoil, to determine relative effects of several variables upon the rates of run-off and erosion. The results showed that for a given amount of rainfall under these conditions the amount lost as run-off depends largely upon the variations in degree of slope, in the amount of organic matter present in the soil and in the amount of moisture in the soil before the rain. On the other hand, the survey indicated that differences in soil porosity, specific gravity, percent of clay and finer material and certain indexes of susceptibility to washing were not related to differences in rates of either run-off or erosion.

Another study showed that variations in rainfall intensities and soil moisture before rains accounted to a large degree for the variation in the rate of run-off from two Guinea-grassed plots. Here, too, variations in the specific gravity of the soil, in soil porosity and in the duration of rains, as well as influences of overhead canopy and of total rainfall per rain, were shown to be of doubtful importance in explaining the variability in run-off. Variations in the organic content and the slope gradients of Guinea-grassed plots were not great enough to be considered in the calculations.

Greatest effect upon variation in rates of erosion from the grassed plots resulted from differences in rates of run-off, and of slightly less consequence was variation in overhead canopy. However, there was no significant effect upon rate of erosion due to variation in duration or intensity of rains, moisture content of the soil before the rains, specific gravity of the soil or soil porosity. Effect of variability of total rainfall per rain upon erosion rates also was of doubtful importance.



The nodule-bearing trailing indigo has a useful job to do in Puerto Rico. These long roots, a 2-year growth in Mucara clay, indicate drought resistance.

Major objectives of experiments with grass and legume mixtures on the research station plots have been to determine which species will increase density and herbage production in order to reduce soil ero-

A 14-month-old pasture of molasses grass on a farm near Mayaguez—slope, 30 to 45 percent; small areas were fenced off, fertilizer and spot seeding employed, contour furrows used.

sion and cut feed costs. Trailing indigo gave excellent results in mixed planting with other species, with the exception of Para grass and wandering jew. A mixture of trailing indigo and Barbados sourgrass apparently is well adapted for dry areas of Puerto Rico since both are drought-resistant.

Trailing indigo proved better than wild grasses as a soil binder below stiff-stemmed grass barriers on banks of bench terraces constructed by normal plowings, although it was shown to be inferior to centipede grass, African digetaria grass and molasses grass as a soil binder. Yielding up to nine tons of green matter a year, trailing indigo compared favorably with several species, including molasses grass, Cogon grass and Manilla grass, from the standpoint of high forage productivity and usefulness in soil erosion control.

Results of study at Mayaguez to date show that pasture grasses have required nitrogen fertilization and that highest yields were secured when a nitrogen-phosphate-lime combination was used. However, the observations are being continued over a longer period of time to obtain more conclusive data on this phase of the pastures project.

Experiments have been carried out on the formation of bench terraces on 20 to 45 percent slopes. It has been found that 80 percent of the earth movement can be accomplished by normal plowings for field crops if a 4½- to 5-foot vertical interval is used between stiff-stemmed plant barriers. Of 5 plants tested for this barrier use, elephant grass ranked best and was followed in order of rank by Guatemala grass, sugarcane, sorghum and bamboo. Terrace banks 2 feet high were formed in 2 years by making 8 plowings causing fill above the terrace and 4 plowings producing cut below the bank. Banks, nearly 3 feet high, were produced in 2 years by 4 plowings above the barrier and by 12 plowings below the barrier line.

Based upon observations at Mayaguez, a bench-terraced acre of lemon grass should produce more than 50 pounds of oil each year. If distilleries for processing the oil were started on the island, it is anticipated that the grower's 40 percent of the oil would return him an annual gross profit ranging up to as high as $70 per acre.

Experiments with soybeans also have been carried out on the research plots. Of 10 different kinds tested, the Clemson and Creole varieties of this vital war crop produced the highest quality and the greatest quantity of seed.

Primarily a study of water and soil conservation, the research work also has developed information on tropical crops of economic and subsistence value to the people of Puerto Rico and of immediate importance to the United Nations' war effort.

The work of these scientific-minded men in the outdoor laboratory at Mayaguez is basic to a continuing productive agriculture in the tropics. With conservation methods as a solid foundation, the future of farming in our Puerto Rican outpost is brightening, even though it must rely upon more intensive methods than anywhere else under the Stars and Stripes.

SOIL CONSERVATION CAN HELP

(Continued from page 274)

gency. We must put what we know about crop management, fertilizers, and soil conservation to work. Soil conservation has a lot to do, not only in increasing yields, both in quantity and quality, but also in feeding the soil through proper rotation, drainage and irrigation, aeration, and the restoration of mineral and organic contents. Streams from our farmlands must once more run clear, and the minerals we sell off the farm must be returned. Soil treatments, including manures, limestone, and fertilizers, are but small additions, yet if properly applied and properly conserved, our land can be made to produce as much or more at the end of this long drain as it did in the beginning. We must see to it that our soil is so treated and so conserved as to supply, no matter how long the war may last, forage that is rich in protein, minerals, and vitamins; so that our meat, milk, eggs, legumes, and cereals shall be rich in all essential factors.

REVIEWS

OUR LANDED HERITAGE—THE PUBLIC DOMAIN, 1776-1936. By Roy M. Robbins, Princeton, 1942.

The conservation movement and the public domain grew up together. For this reason conservationists have an especial interest in "Our Landed Heritage." In it Dr. Robbins has placed in their proper political and economic settings those hangovers from the past that, even today, tend to retard the progress of conservation.

From the beginning of our history, Americans had been prodigal of their land. The supply seemed inexhaustible. By 1802, the Federal Government already possessed 259 million acres ceded to it by the seven original states with claims to western lands. The next year the public domain was quadrupled by the purchase of Louisiana Territory. By the time the country attained its full territorial growth, the Government had acquired in all nearly 2 billion acres of public land through cession, treaty, or purchase.

Until permanent settlement began to penetrate beyond the Mississippi, there was little national concern about conservation. Revenue from the sale of lands, the peopling of the West, and the dangers of land speculation were more immediate problems. Beyond the 100th meridian, the gradual decrease in rainfall from east to west became pronounced. The 160 acres granted by the Preëmption Act of 1841, and by the Homestead Act of 1862, were designed for humid regions and proved inadequate for the semiarid Great Plains, where drought recurred with disconcerting irregularity. To the farmer the Government's offer of land was guarantee enough that farming was both possible and practical. Both assumptions at times proved false. Within a few years after settlement, crops failed, and the soils began to blow. Cattle raising was not profitable on small farms, and irrigation was limited by availability of water. Relief measures followed in rapid succession. These were not actually conservation measures, but rather their forerunners. Because they were not based on scientific knowledge of the land and the actual needs of settlers, relief legislation, like the Timber Culture, the Desert Land, and the Enlarged Homestead Acts, not only failed in its objectives but, in addition, opened new loopholes for speculation.

Each failure was accompanied by increased recognition of the need for conservation. As early as 1878, Maj. John W. Powell recommended the classification of land according to its best use, the discarding of worn-out land legislation, and the granting of lands in amounts proportionate to the practical needs of settlers. In his inaugural address, President Hayes even went so far as to suggest leasing on the Great Plains and the legalizing of the cattle industry. The National Academy of Sciences recommended scientific surveys of the public domain, the Geologic Survey was established, and the Public Land Commission was created to investigate the land problem. Each proposed reform affected somebody's vested interests adversely — the cattlemen, mining interests, States anxious to develop their resources as rapidly as possible, lumber magnates, or railroads. When the President was granted the right to establish forest reserves, it was condemned as an "extraordinary and dangerous power."

Interest in conservation also ebbed and flowed with sectional rivalry: the North against the South, the industrial East against the agricultural West, public land States against those without land, cattle regions against agricultural. Each faction had a modicum of right on its side but its interests were essentially local and selfish. Finally, in 1908, Theodore Roosevelt called a conference of the State governors largely for the purpose of formulating a uniform public sentiment on problems of conservation. A quarter of a century more elapsed before the passage of Taylor Grazing Act, the closing of the public domain to private entry, and the establishment of the Soil Conservation Service. These three events came almost simultaneously and had as their common goal the conservation of the natural resources of our country.—Reviewed by Lois Olson.

IMPROVING RANGE CONDITIONS FOR WARTIME LIVESTOCK PRODUCTION. Fred G. Renner and Eric A. Johnson, United States Department of Agriculture Farmers' Bulletin No. 1921. December, 1942.

The demands of the armed forces and civilian population both in this country and abroad for an adequate supply of meat products and wool have focused attention on the range lands of the country on which most of the livestock raised in the United States is produced. It has been recognized for years that, by and large, these lands are not producing forage to the extent of their greatest capacity. Both ranchmen and range technicians have recognized that some ranges are more productive than others and that individual ranges can be restored to higher levels of productiveness, but up to this time no generally accepted standards for determining and classifying the condition of ranges have been established.

The authors have drawn from many years' experience in examining and analyzing ranges, from

investigative work in the field of range management, and from the practical experience of farmers and ranchers in the preparation of this bulletin. A method of classifying range condition is described, and the identifying characteristics of ranges in different stages of productivity are presented. The publication also sets forth the principal conservation practices which practical experience has found to be effective in improving range conditions. Conservative stocking, the key to all improvement measures, is stressed. Other time-tested management practices recommended include the proper seasonal use of ranges, deferred and rotation grazing, consideration of range condition in dividing the range into pastures, distributing salt in unused portions of the range, relieving ranges in poor condition by establishment of properly spaced, adequate and dependable water supplies, use of fences as a means of distributing livestock on the range, use of good herding and bedding methods, and grazing the range with the kind and class of livestock for which the forage and range are best suited.

DEATH OF DR. JAY A. BONSTEEL

WITH THE DEATH OF Dr. J. A. Bonsteel, two days before he was to retire from a long career of public service, the thoughts of those who knew him intimately turned back to the early days of soil survey work in the United States.

At that time—at the dawn of the 20th century—Dr. Bonsteel, Milton Whitney, Clarence Dorsey, G. N. Coffey, W. E. Hearn, Macy H. Lapham, W. T. Carter, and other land specialists were undertaking to bring some order out of the chaos of meaningless terms that characterized our unscientific ways of classifying the soils of the country. This small group originated soil classification and soil surveying in America.

Long before the turn of the century, workable systems for classifying rocks, minerals, chemical elements, plants, and animals had been established; but there was no scientific system of soil classification. Such vague terms as "freestone land," "limestone soil," "sandy soil," "red clay," "river bottom," "white-oak land," "oak hammock," "bay heads," "savana," "pocosin," "custard apple," "crawfish land," "cowhide land," and many others were in common use throughout the Americas. For the most part, these indefinite terms were not only inadequate but generally misleading, even in the localities where they were most commonly used.

Dr. Bonsteel made an outstanding contribution to the development of soil classification and soil mapping. It was not easy in those early times to persuade people—farmers or scientists—that what we had in the way of soil classification was far short of what the country needed. Often the early surveyors were thrown off farms—bodily sometimes—and turned away from the doorsteps of the too-common type of disinterested laboratory and indoor agricultural technicians. In those days, bulletins dealing with experimental results obtained on a single one of the many soil types of a state were being published and distributed broadcast, without a thought that the information might have a very restricted geographic applicability because of some variation of soil or climate that easily could have influenced (often did) the outcome of the experiment and, therefore, the applicability.

Bonsteel saw much of the country and profited by what he saw. Not only did he contribute greatly to the establishment of a scientific system of land classification, but he never lost sight of the aspects of utility in connection with soil survey work.

Since those early days, a vast amount of knowledge with respect to soils has been accumulated and, quite naturally, improvements have been made in the techniques of classification and surveying. Other methods of land classifications have had to be developed to meet the needs of those who work with the land. The land capability survey, developed in the Soil Conservation Service, is an example of a new type of survey that had to be developed for the needs of soil conservation work. And Bonsteel has assisted with the development of this new tool for applying soil conservation measures to the land according to its needs and adaptability.

Dr. Bonsteel retired from the Soil Survey in 1920, but was called back to government service in 1935 by the Soil Conservation Service to help with the development of the new science and practice of soil conservation. Again, in this work, his contributions are serving his country well.

In helping with the establishment of a sound soil conservation program on a national scale, Bonsteel's life experience of technical and practical work on the land has come to a highly beneficent fruition; for it turns out that more than anything else a good job of soil conservation—for which he worked so earnestly—gives the greatest returns in the way of increased per-acre yields that now are needed as never before in our history.

These brief words give scarcely a glimpse of the lifework of this worthy man, who did so much for his country; but they come out of the recollections of one who has long worked very closely and understandingly with his good friend, Jay Bonsteel.—HUGH H. BENNETT.

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Compiled by ETTA G. ROGERS, Publications Unit

Field offices should submit requests on Form SCS–37, in accordance with the instructions on the reverse side of the form. Others should address the office of issue.

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[1] From Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

The fair serenity that is rural Vermont's is well told in this long look down a country lane. The lacy leafiness of ceiling, the venerable sentinels along the sides, the draft team proud in its high-massed load of hay, the master high-perched on his good bounty—all bespeak the rugged confidence and sound husbandry of liberty-loving New England.

Here is the scene as it ought always to be. Calm, safe, and beautiful. A refuge from the horrors and the hazards and the tensions that beset millions of men, women, and children today.

Unfortunately, as John H. Wetzel observes in his article within these covers, wartime farming is actually one of the most dangerous of all occupations. Accidents take a bigger toll than in industry and become a major factor in the farm-labor situation. He asks the enlistment and cooperation of all of us in an educational campaign to insure greater safety on the farm, pointing out the imperative necessity of better *human conservation*.—THE EDITOR.

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